CHAPTER 3

COMPUTER OPERATOR CONTROLS AND CONTROLLING UNITS

INTRODUCTION

Although the computer can operate automatically under program instruction control, provisions to operate the computer manually are available. You may use keys and switches to affect overtall computer operation, control parts of the operation, provide specific jump or stop conditions, or govern the speed of operation. You may use pushbutton indicators to modify all or part of the contents of registers. The computer's technical and owner's manuals, desktop guides, and system operating manuals are all excellent sources of information you can use to learn the operations of a computer and the functions of a particular system. Learn how to operate the computer in all modes to enhance your abilities as a technician.

After completing this chapter, you should be able to:

- **List the ways a technician can interface with a computer—the operator controls generally available**

- **Describe the types and functions of controls, indicators, keys, and switches usually available on operator and maintenance panels, display control units, keyboards, and teletypes to control computers and how they work**

- **Describe the controls and indicators used to monitor computer power and temperature**

- **Describe remote operator consoles and the ways to interface with the computer from a remote console**

Let's start your study of controls with the types you will find with computers. We examine how they work. Then we discuss the different types of controlling and monitoring units with which you will be working. When we discuss these controlling and monitoring units, we discuss the different types of functions usually associated with each unit and the types of controls used to activate these functions.

TOPIC 1—TYPES OF COMPUTER OPERATOR CONTROLS

To monitor operations or perform maintenance on a computer, you must understand how to manipulate the computer's controls to initiate operations and to accomplish maintenance. Controlling units vary with the different types of computers; but if you understand the basics, you can initiate operations and perform maintenance on any type of computer. Let's take a look at the types of controls used—their functions and uses.

POTENTIOMETER CONTROL

As a rule, potentiometers are associated with a control. Potentiometers are usually used to vary

the speed of an internal computer clock or to vary the intensity of indicators used on a controlling device.

DISPLAYS

Some computers use a display of alphanumeric characters to provide computer status of the functional areas and for operator interfacing. You can find the interpretation of displayed information in the technical manual or owner's manual. The displays can be used when the computer is in an operational mode or a maintenance mode. Some computers use a dot matrix display; others use light-emitting diodes (LEDs) to display the alphanumeric characters. Some computers use a small three- or four-digit display to display an address and its contents. Other computers use larger displays. For example, one computer has a large display consisting of up to 44 alphanumeric characters per line and up to 6 lines. One portion of the display, when used for status, does not vary. The other portion, the operator interfacing part, varies in accordance with the types of operations being run at the time. The technology used with the operator interfacing portion of the display is ac plasma. This enables you to monitor operations.

HOURS (TIME TOTALIZING METER)

Time totalizing meters show the total number of hours power has been applied to a unit or module. They usually use a four-digit display to indicate the number of hours. The display is similar to the odometer of an automobile.

INDICATORS (LIGHTS)

The simplest way to show the status of an operation or a selected item is to turn on a light. Indicators usually come in several varieties— backlit indicators, color indicators, and clear indicators.

• Backlit indicators —The light bulbs are covered by a flat lens cover with clear alphanumeric cutouts that appear lit when the lamp is on.

• Color indicators —The light bulbs are inserted in a small solid colored casings with or without letters or characters. The whole casing glows when the lamp is lit. The casing can be square or round.

• Clear indicators —Clear indicators are the same as the colored variety, but the casing is clear and usually round.

PROTECTIVE DEVICES

Protective devices can serve as controls. They are used in computers to prevent damage to the computer or to warn you of conditions that could be potentially dangerous. Circuit breakers and guards are two ways we can protect the computer. Audible alarms are sometimes used to alert us to potential problems.

• Circuit breakers —Circuit breakers remove ac input power when current becomes too high (i.e., internal short circuit).

• Guards —Guards are used to prevent accidental activation of selected keys and switches. A guard can be a clear lens that covers the key/switch or it can be a red cover. In either instance, the cover must be flipped up to gain unrestricted access to the key or switch.

• Audible alarms —Computers often use an audible device, installed internally. These devices can provide a warning that an abnormal condition is about to take place, or they can sound an alarm when an abnormal condition is in progress.

SWITCHES

Switches are used to turn a unit on or off, to activate a function, or to set a parameter. You can activate switches by depressing them or flipping them up or down. Some switches are combined with an indicator to tell when they are activated.

Switches can activate an immediate response in computer operations. They can also be used to set parameters when the computer is being operated. Let's take a look at the different types of switches associated with computers. They include key switches, position switches, pushbutton switches, toggle switches, and two-position switches. See figure 3-1 for examples.

Key Switches

To activate key switches, you lightly depress the keys. Some keys are combined with an indicator. Two types are generally found on computer controlling units—alternate-action keys and momentary-action/ contact keys.
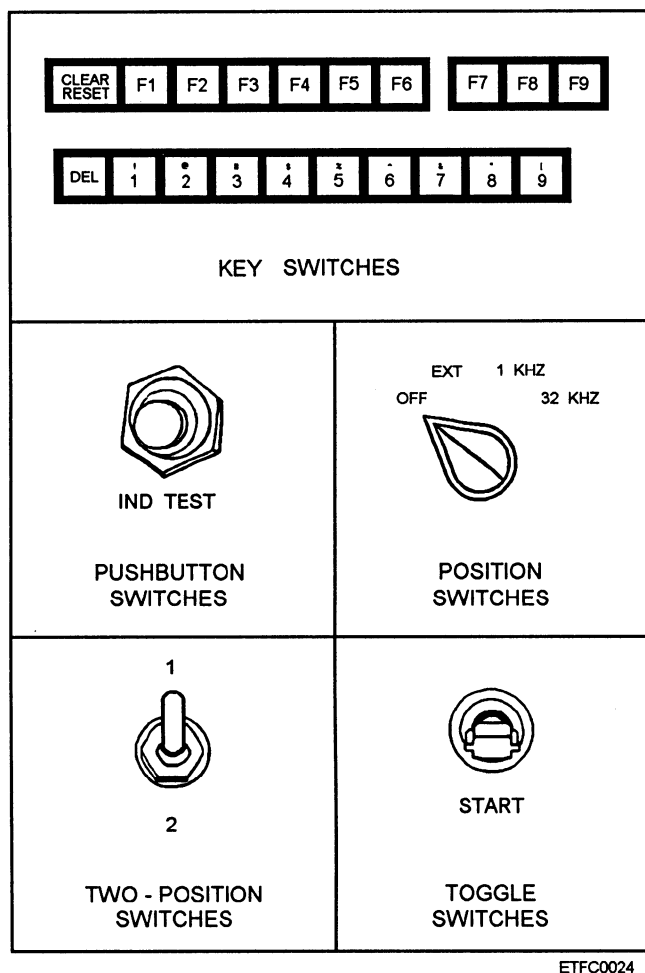
Figure 3-1.—Examples of switches used with computers.

continuously. Also some momentary-action/contact keys are backlit to indicate they are actuated.

Position Switches

Two types of position switches are used on computer controlling units. They are the rotary and thumbwheel switches.

● Rotary switches —Rotary switches usually have several positions the operator can select by turning a knob. The values for the positions are usually marked on the controlling unit's cover. The position selected by the operator can be locked in that position until the operator selects another position.

● Thumbwheel switches —Thumbwheel switches are rotary position switches with alphanumeric characters built into the switch to indicate their position or value setting. You dial the alphanumeric settings on the switch in a manner similar to dialing the numbers on a thumbwheel combination lock. Each position is locked until you select another position.

Pushbutton Switches

Pushbutton switches may or may not have indicators.

● Pushbutton non-indicator switches — Depressing a pushbutton non-indicator switch usually activates a function instantaneously. On some units and depending on the function, holding the pushbutton down continuously will have no effect. On other units, the function will be continuous until the pushbutton is released.

● Pushbutton indicator switches —Pushbutton indicator switches can be used manually to select a function or mode, to input data to the computer, or to indicate status automatically when under the control of the computer's software. Lens colors vary on pushbutton indicator switches. Also, on some pushbutton indicators switches, the lamp and switch are separate. This enables you to replace either the lamp or switch. On other pushbutton indicator switches, you must replace the whole item; the lamp and switch are not separate.

● Alternate-action key switches —When you depress a key, it activates that function. Alternate-action keys come in a couple of varieties. With one variety, you simply depress the key to activate the function. To deactivate the function, you depress the key again. The second variety is the inward/outward variety. The function is activated when the key is latched inward and disabled when the key is unlatched outward. Some alternate-action keys have an indicator light telling you the function is active. These are called indicating keys/switches. Non-indicating lamp keys are the same as indicator keys except no indicator light shows the function is active.

● Momentary-action/contact key switches — Momentary-action/contact key switches operate on the principle that depressing them one time momentarily activates a function or sends data to the computer. Some momentary-action/contact keys are designed so that when you hold down the key, it repeats the function

Toggle Switches

Toggle switches work in several different ways: Let's examine the three most common types— alternate-action; momentary-action/contract, two-position; and three-position.

• Alternate-action toggle switches —Alternate-action toggle switches can be permanent up and return to neutral, or they can be permanent up or down. Placing the switch in a permanent up position will turn a unit on or off, activate a function, or set a parameter. Returning the switch to the center position (neutral) may or may not interact with the computer's software. Placing the switch in permanent up or down position can also cause an immediate or delayed response from the computer's software.

• Momentary-action/contact, two-position toggle switches —Momentary-action/contact, two-position toggle switches are usually used to initiate an operation or perform a function. Depressing the switch down momentarily activates this switch, and it will then return to a neutral position (center) when not being used.

• Three-position toggle switches —Three-position toggle switches operate basically the same way as the momentary action/contact, two-position toggle switches except one more variable has been added. These switches can be placed in a locked up position, left in the center position (neutral), or in the down position, which can be a momentary-action or locked down position. The center position may be used to set a parameter, or it may be used to disable the locked up/down position.

Two-Position Switches

Two-position switches can be left in an up or down locked position. In either position there will an immediate response.

TOPIC 2—TYPES OF COMPUTER CONTROLLING UNITS AND THEIR CONTROLS

We have discussed the types of controls that are associated with controlling units. Next you'll study the different types of controlling units associated with computers. It is important to note that not all types of controlling units are used to control every computer. You will not find each and every one of these controlling units on every computer you operate and maintain. However, some computers have a combination of two or more of these controlling units to enable you to operate and perform maintenance on the computer. To show you how controls and indicators are generally labeled on drawings, we selected several examples and have presented them in figures. These examples point out many of the controls and indicators used on controlling units.
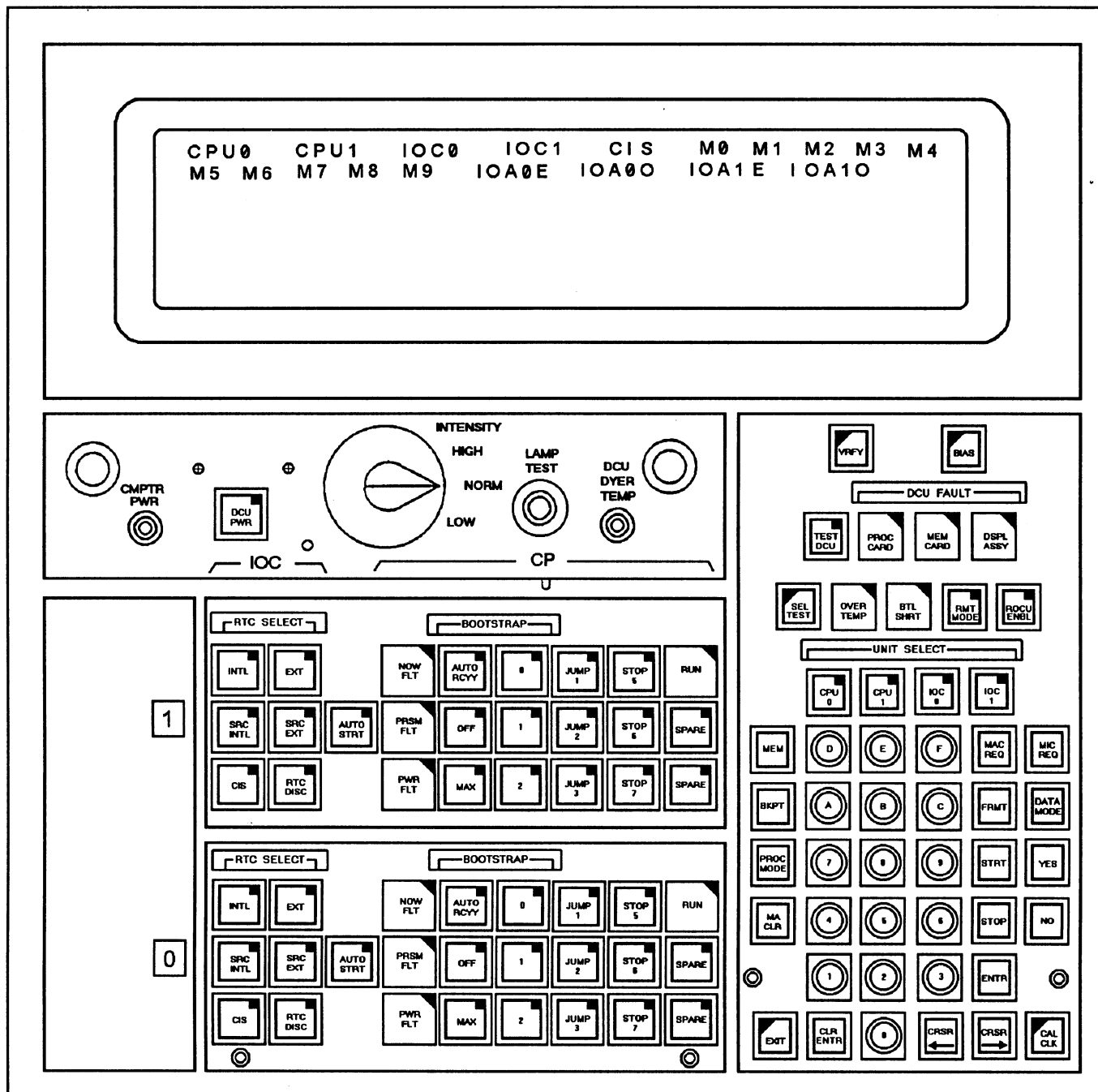
Learn the capabilities and limitations of each of these controlling units to enhance your abilities to operate and maintain any type of computer. We do not go into a detailed discussion of these controlling units, but rather we discuss the tasks they are capable of performing. You will find the operation of the controlling units in the computer's technical or owner's manual. In the operation or initial setup section of the technical or owner's manual, you will find a general description of the controlling unit or units on your system. It will give the operation, an illustration, and tables and figures to describe each control and indicator used by the computer or associated equipment. Manuals that have a functional description section provide all details of operation. Controlling units are also supported by circuit diagrams (prints) that contain information you can use to perform maintenance.

All controls and indicators are important; be particularly aware of controls that when activated interact with computer operations. Computer operations include those operations that are executed by programs/software as well as manual operations activated when performing corrective maintenance. The programs and software include the diagnostics used to perform preventive maintenance as well as the operational programs. An example of a manual operation would be a short maintenance program you would assemble and manually load into the computer and run to check a specific function of the computer.

Know and understand the controls and indicators thoroughly. They are your means of monitoring computer operations and an aid when you perform maintenance. Detailed information of every control and indicator will include the following:

• The name of the control or indicator

• Type of control or indicator

• Function and use of the control or indicator

Figure 3-2 is an example of a typical controlling unit for a computer.

```
CPU0    CPU1    IOC0    IOC1    CIS    M0 M1 M2 M3 M4
M5 M6   M7 M8   M9      IOA0E   IOA0O    IOA1E  IOA1O
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KEY SWITCH

KEY SWITCH / INDICATORS

INDICATOR

KEY SWITCH / NON - INDICATING LAMP (LIT ONLY DURING LAMP TEST AND DCU TEST)

Figure 3-2.—Example of a typical controlling unit

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Table 3-1.–Part of a Table Detailing Controls and Indicators of a Typical Controlling Unit

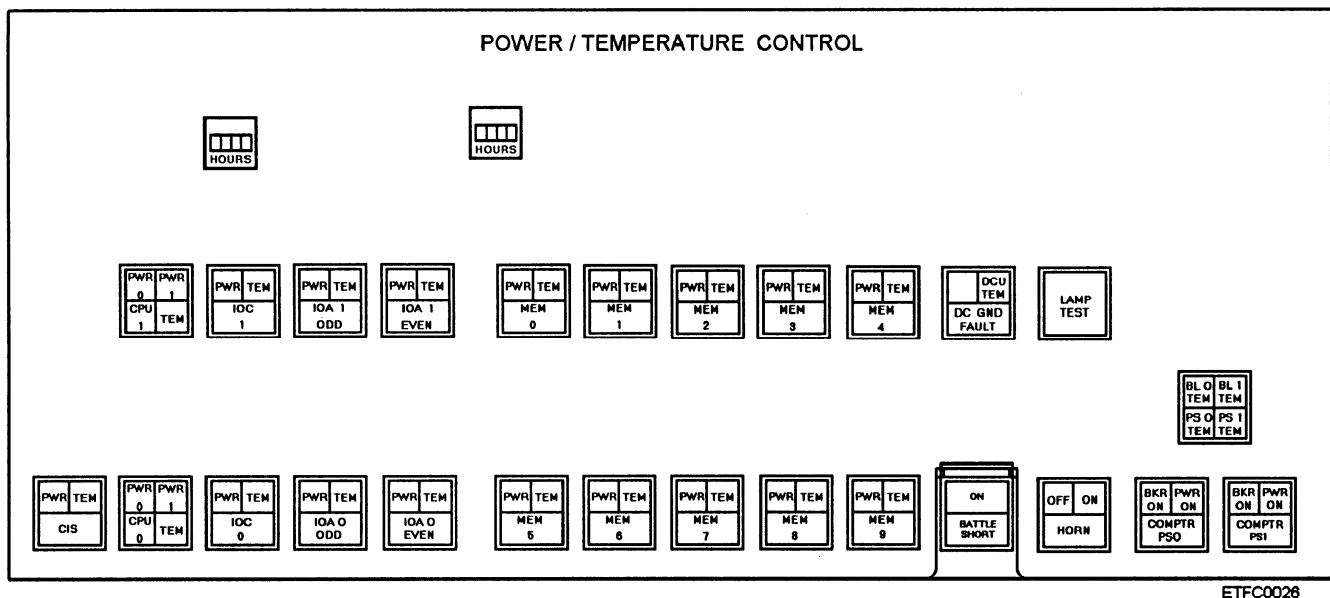| CONTROL OR INDICATOR	TYPE	FUNCTION AND USE
DCU PWR	Alternate-Action Switch with Indicator	Controls application of computer power to DCU power supply line replaceable unit (LRU). With power on, switch is maintained depressed. Lit indicator shows that logic voltage is present at output of DCU power supply LRU.
CMPTR PWR	Indicator (Green)	When lit, power is present at output of computer primary power supply (PPS).
LAMP TEST	Pushbutton	Lights all indicators when depressed. Indicators are not lit when switch is released except those previously lit.
INTENSITY	Rotary Switch (HIGH, NORM, LOW)	Selects brightness of the DCU display (4, 15, or 30 footlamberts).
DCU OVERTEMP	Indicator (Yellow)	When lit, overtemperature exits in DCU.
DCU FAULT		
PROC CARD	Indicator (Red)	Lit when failure of DCU processor LRU exists.
MEM CARD	Indicator (Red)	Lit when failure of DCU memory LRU exists.
DSPL ASSY	Indicator (Red)	Lit when failure of DCU display LRU exists.
TEST DCU	Key-Indicator	Starts DCU self-test.
DIAG	Key/Non-indicating Lamp	Starts diagnostic program for module shown failing by display; or all modules (if off line) and no failed modules.

Figure 3-3.—Example of a power/temperature panel (P/TP).

Table 3-1 is an example of a table that contains detailed information about the controls and indicators—the name, type, and function and use of the controls and indicators. Other documents that are useful and provide information are system operating manuals and desktop guides.

Let's take a look at some of the controlling units used to control the computer. We begin with the units that only control the computer's power and move to the units you can use to remotely operate a computer.

POWER/TEMPERATURE PANELS

Power/temperature panels (P/TPs) provide power controls and indicators and temperature indicators. They may also provide a running time meter, a lamp test, a battle short switch, and an alarm to notify you of an overtemperature condition. Refer to figure 3-3 for an example. Power/temperature panels allow for the powering down and up of the individual modules within the computer's frame or cabinet. This enables you to remove a designated module for repair.

On any computer controlling unit that has provisions for controlling the computer's power, you must become familiar with the correct procedures for routine powering up/down and emergency situations. These procedures can be found in the computer's technical or owner's manual, system operating manuals, desktop guides, or locally generated system doctrine. In our example, the power/temperature panel is located on the front of the computer's frame/cabinet for easy access and monitoring. This power/temperature panel has four levels of controls and indications. They are as follows:

- Primary power
- Computer power
- Module power
- Overtemperature indications

OPERATOR PANELS

Operator panels contain the controls and indicators necessary to initiate computer operations including powering the computer up and down. They also enable you to monitor the computer during operations for logic power status, overtemperature conditions, programmed stops, and faults (power, program, and hardware), and test indicators. You can enable or disable the audible device and put the computer in a battle short condition. See figure 3-4. You can divide the operator panel into the following four areas:
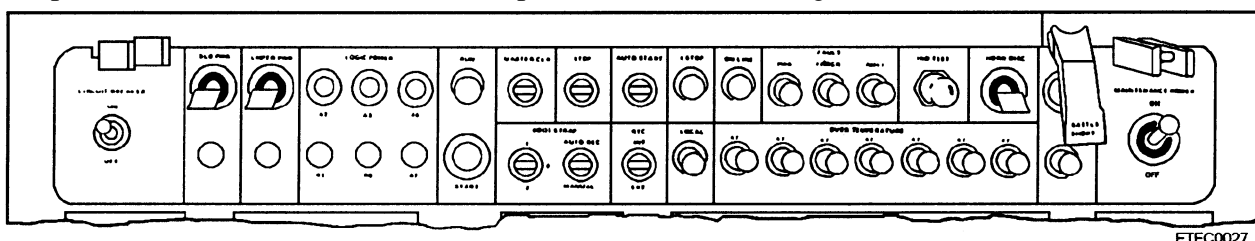

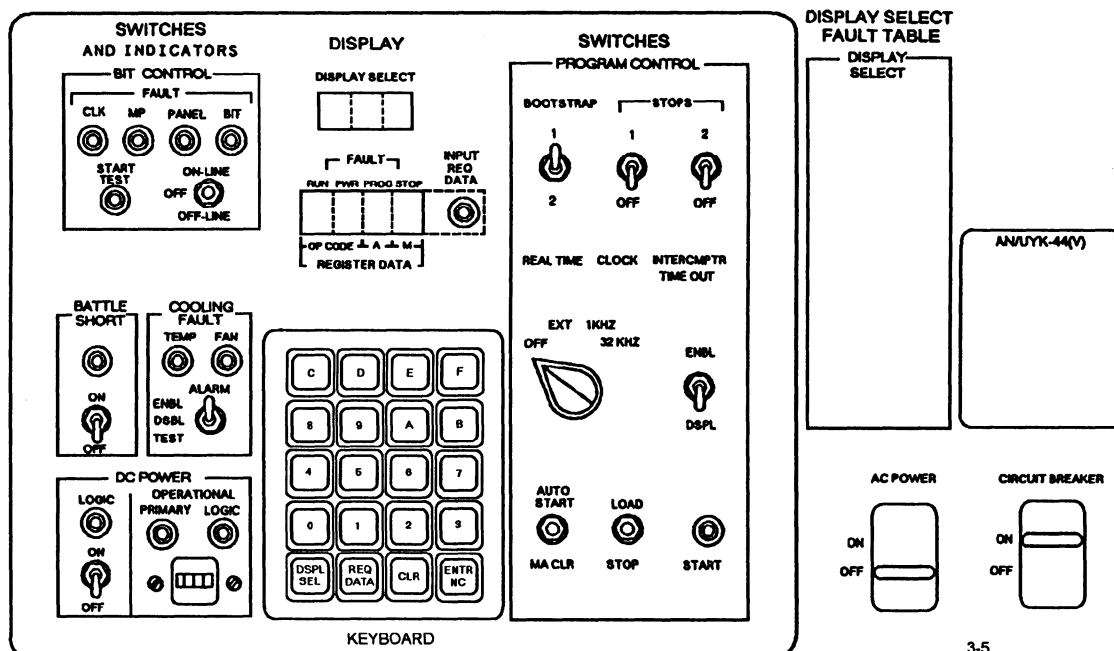**Figure 3-4.—Example of an operator panel.**

Figure 3-5.—Example of a control and maintenance panel (CMP).

- Power controls and indications

- Initiate computer operations controls

- Operations and temperature indications

- Battle short controls and indications

The operator panel only allows for powering up/down the maintenance console and the modules within the computer's frame or cabinet. It does not allow for powering up/down individual modules. Just like the power/temperature panel, you must become familiar with correct procedures for routine powering up/down and emergency situations. You will find these procedures in the computer's technical or owner's manual, system operating manuals, desktop guides, or locally generated system doctrine.

The operator panel is located in the frame or cabinet above the logic chassis. The operator panel has five levels of controls and indications as follows:

- Power (blower, logic, and battle short)

- Logic power indications

- Overtemperature indications

- Initiate computer operations

- Monitor computer operations

CONTROL AND MAINTENANCE PANELS

Control and maintenance panels (CMPs) have controls for powering up/down the computer, loading and operating programs, initiating computer operations, and testing the computer. Again review the procedures for routine and emergency power up/down procedures. You can divide control and maintenance panels and their controls and indicators into seven physical areas. They are as follows:

- Ac power controls

- Program controls

- Operator interfacing (displays and keyboard)

- Built-in-test (BIT) controls and indicators

- Battle short controls and indicators

- Cooling fault controls and indicators

- Dc power controls and indicators

The panel in our example (fig. 3-5) also lists some of the information that can be displayed in the Display Select or Fault. You can monitor operations using the display and indications; and you can interface (using inspect and change procedures or manual operations) with the CPU/IOC and memory using the display and keyboard. Computer monitoring capabilities during operations and maintenance include switch settings, hardware availability, halts, jump stops, and operator input. Remember that key settings can interact with computer software.

This control and maintenance panel is usually located in the front of the frame/cabinet. It has six levels of controls and indications. They are as indicated:

- Power (primary, logic, and battle short)

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CPU0    CPU1    IOC0    IOC1    CIS    M0 M1 M2 M3 M4
M5 M6   M7 M8   M9    IOA0E   IOA0O   IOA1E  IOA1O
```

KEY SWITCH   INDICATOR

KEY SWITCH / INDICATORS   KEY SWITCH / NON - INDICATING LAMP (LIT ONLY
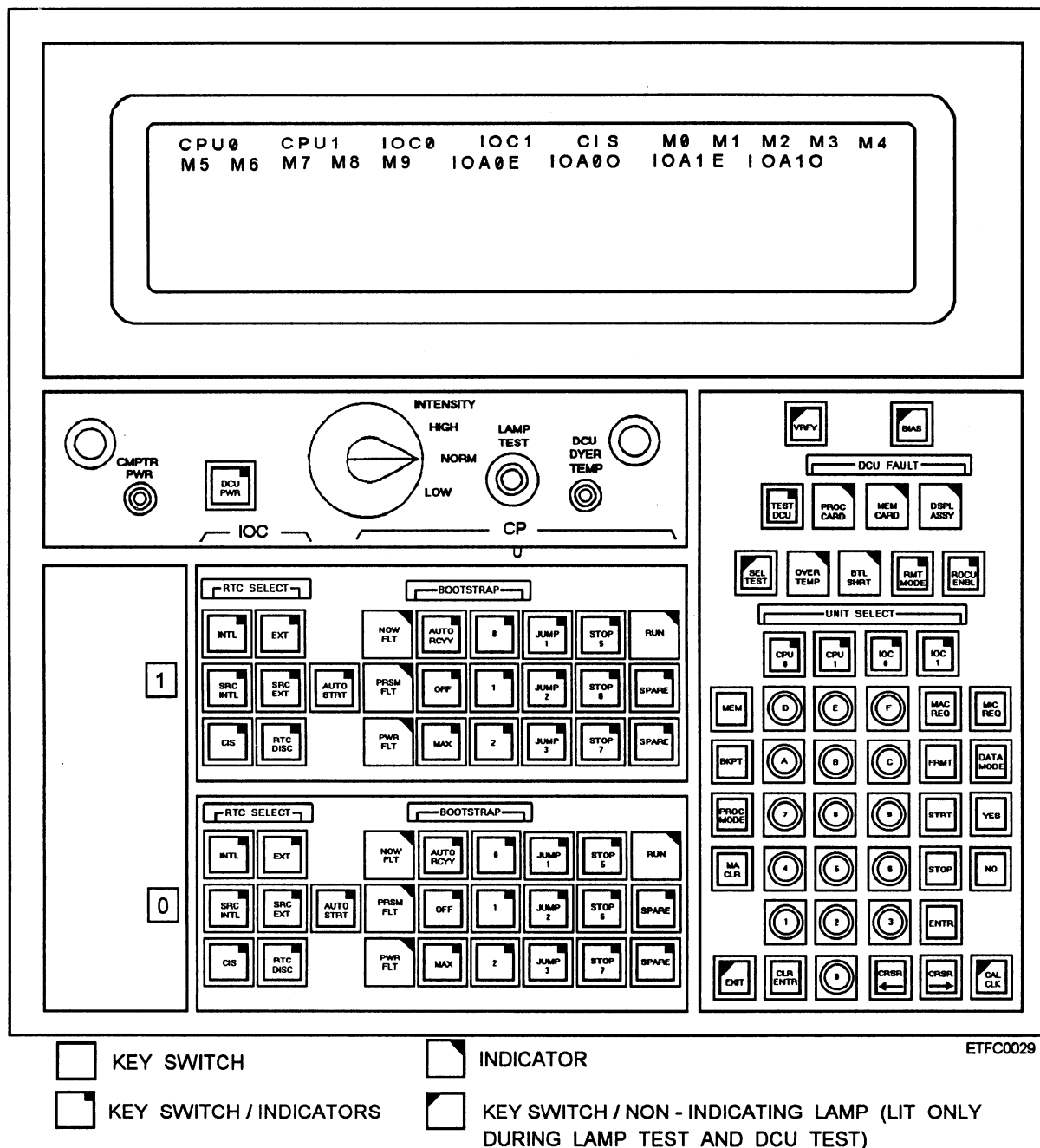   DURING LAMP TEST AND DCU TEST)

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Figure 3-6.—Example of a display control unit (DCU).

- Loading and initiating operations

- Operator interfacing

- Testing

- Logic power indications

- Overtemperature indications

DISPLAY CONTROL UNITS

Display control units (DCUs) have controls and indicators for powering up/down the DCU, loading and operating programs, initiating and monitoring computer operations, battle short operations, and testing the computer. Although you can only control

DCU power, it is a good idea to review the power up/down procedures for the computer set. DCUs have operator panels and alphanumeric displays and can be divided into four physical areas. They are as follows:

- Display

- DCU panel control

- CPU (bootstrap) and IOC (Real-Time Clock [RTC] Select)

- Operations and testing

See figure 3-6 for an illustration. You can control up to two CPUs and IOCs with this DCU. The keys used by

the DCU have surrounding barriers and interlocks to prevent accidental key action. The DCU display visually helps you to make the correct entries. The dot matrix display has six 44-character lines of status and maintenance data. You can monitor operations using the ac plasma display and the indicators. Interfacing (inspect and change and manual operations) with the CPU/IOC and memory is accomplished using the key switches. Monitoring capabilities include switch settings, hardware availability, halts, jump stops, breakpoints, and operator input. Remember that key settings can interact with computer software.

This DCU is located in the front of the frame/cabinet. The DCU has a built-in microprocessor with five levels of controls and indications. They are as follows:

- Loading and initiating operations

- Monitoring operations

- Status indications

- Operator interfacing

- Testing (self)

COMPUTER CONTROL PANELS

Computer control panels are used to power up the CPU and for manual START, HALT, CLEAR, register display, and bootstrapping. The controls can initiate and monitor computer operations and load diagnostics contained on magnetic tape from an external peripheral unit. Then, from a data terminal, you can perform diagnostics on the computer. Monitoring capabilities include switch settings and display registers. Remember that key settings can interact with computer software. Some computer control panels limit their

access to authorized personnel only. A locked security cover must be removed to gain access to the panel's switches. Figure 3-7 is an illustration of a computer control panel. This computer control panel has three levels of controls and indications. They areas follows:

- CPU power

- Initiate computer operations (includes maintenance)

- Monitor computer operations

MAINTENANCE CONSOLES

Computer logic test sets (maintenance consoles) allow you to operate the computer set under expanded, and varied conditions, and at various speeds and various operating modes. The maintenance console's primary purpose is to enable you to monitor instruction words and input/output commands and their execution, and to view the contents of various arithmetic and control registers. Monitoring capabilities include switch settings, hardware availability, halts, jump stops, breakpoints, and operator input. Remember that switch settings can interact with computer software. The maintenance console can be divided into three physical areas. They are as follows:

Maintenance console control and indicator status

CPU portion

IOC portion

Refer to figure 3-8 for an illustration. This maintenance console may be located up to 15 feet from the computer set; but it is not designed to be mounted permanently atop the computer's cabinet. The maintenance console receives its power from the operator panel when online. When the maintenance
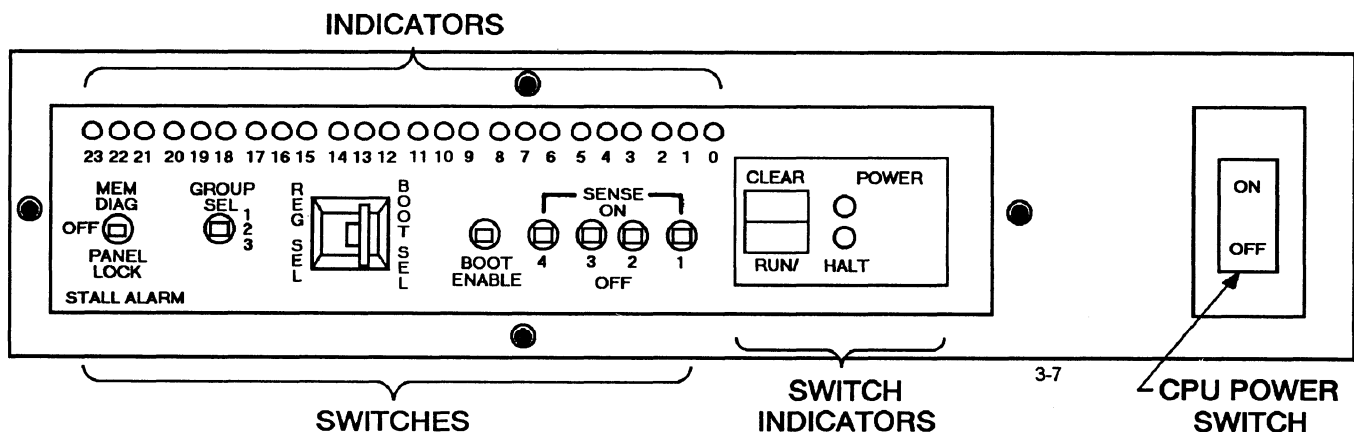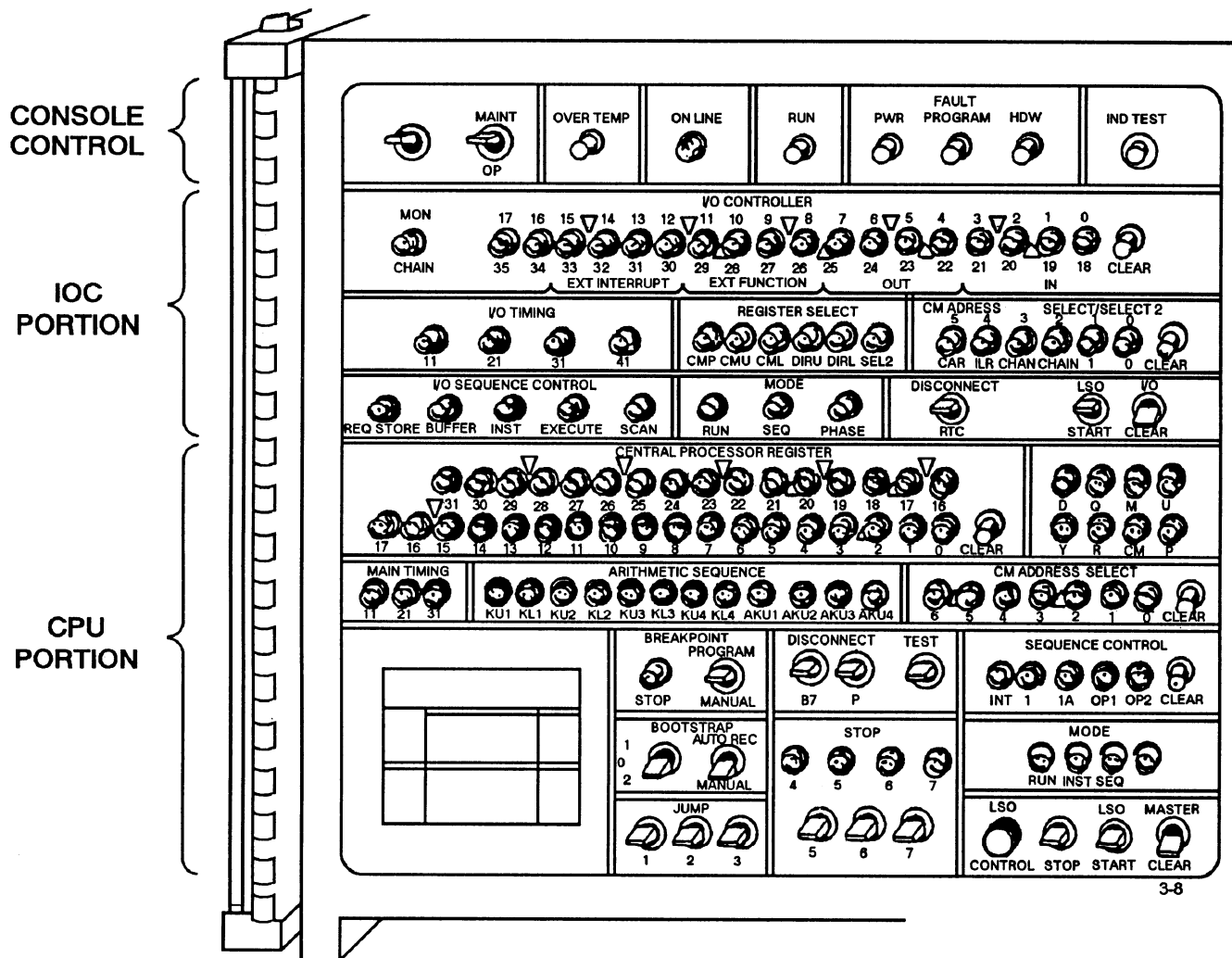

Figure 3-7.—Example of a computer control panel.

Figure 3-8.—Example of a maintenance console.

console is operational, its controls override those of the operator panel but not the remote operator console. The registers on the maintenance console are represented by pushbutton indicators. During operations, the registers provide status. Signals generated by the maintenance console, CPU, and IOC are displayed by the pushbutton indicators. The indicators can indicate that the computer is talking to other subsystems, such as the display or link subsystems. Monitoring the registers and controls is also performed during periods of preventive maintenance or when a computer malfunction occurs.

During maintenance you can set parameters or you can manually control the computer using different modes and varying speeds. Another useful function is inspect and change, where you can manually interface with the CPU and IOC for software enhancement. The maintenance console has the following four levels of controls and indications:

- Console indications

- Initiate computer operations

- Monitor computer operations

- Testing (automatic and manual)

KEYBOARDS

Keyboards are your primary means of controlling the operations of microcomputers. They are also used in minicomputers and mainframe computers. They will probably be your main means for inputting programs and data into microcomputers/PCs. A monitor (color or monochrome) is used with the keyboard to view and monitor the operations. A monitor is a microcomputer's principal means of providing information to you. The monitor allows the microcomputer to communicate its actions to you, so that you can act upon those actions using the keyboard to accomplish whatever job you are doing. From a keyboard,

operation and maintenance of a microcomputer can be accomplished.

Keyboards come in many shapes and sizes, have different numbers and arrangements of keys, differ in respect to touch, and have special keys to allow you to communicate specific software commands. Most manufacturers have designed their keyboards as separate devices so you can place them wherever it is convenient (even in your lap). Other manufacturers have designed their keyboards into the display/monitor device or system unit.   Refer to figure 3-9 for an illustration of a typical keyboard used with a PC.

The important things you need to know about keyboards are the types of keys and the function and the placement of each key. All keyboards have the alphabetic characters (upper and lower case), numbers, and some special characters. In addition, keyboards have special function keys and control keys that are defined by the operating system or the program. It is important to remember that any key or combination of keys can be assigned special meaning by a program. Therefore, the keys may have different meanings and functions depending on the program you are using. Once again, we remind you, read all the documentation that comes with each program and with the computer system. The keyboard has the following three levels of controls and indications:

• Initiate computer operations

• Control computer operations

• Testing

In addition to a keyboard, a microcomputer may have a mouse. The mouse can be used with the monitor as a controlling device after the computer has been booted and the operating program has been initialized. The operational program must be specially designed to interface with a mouse.

TELETYPES

Teletypes can be used as input/output communications consoles (IOCCs). They are used primarily as means of inputting information to the computer and receiving information from the computer. Teletypes have a keyboard for inputting and a printer for outputting.   Once you have loaded the programs/ software (operational or maintenance) into the computer, an IOCC or terminal of control (TOC) is used to initialize the programs and communicate with the computer when operating during operations or maintenance.   You use the keyboard to give the computer commands and parameters and the printer portion to repeat back commands and parameters and provide status of equipment or software and test completions.

The commands used to communicate with the computer are specific to the operating system and the operational or maintenance programs. You can find the
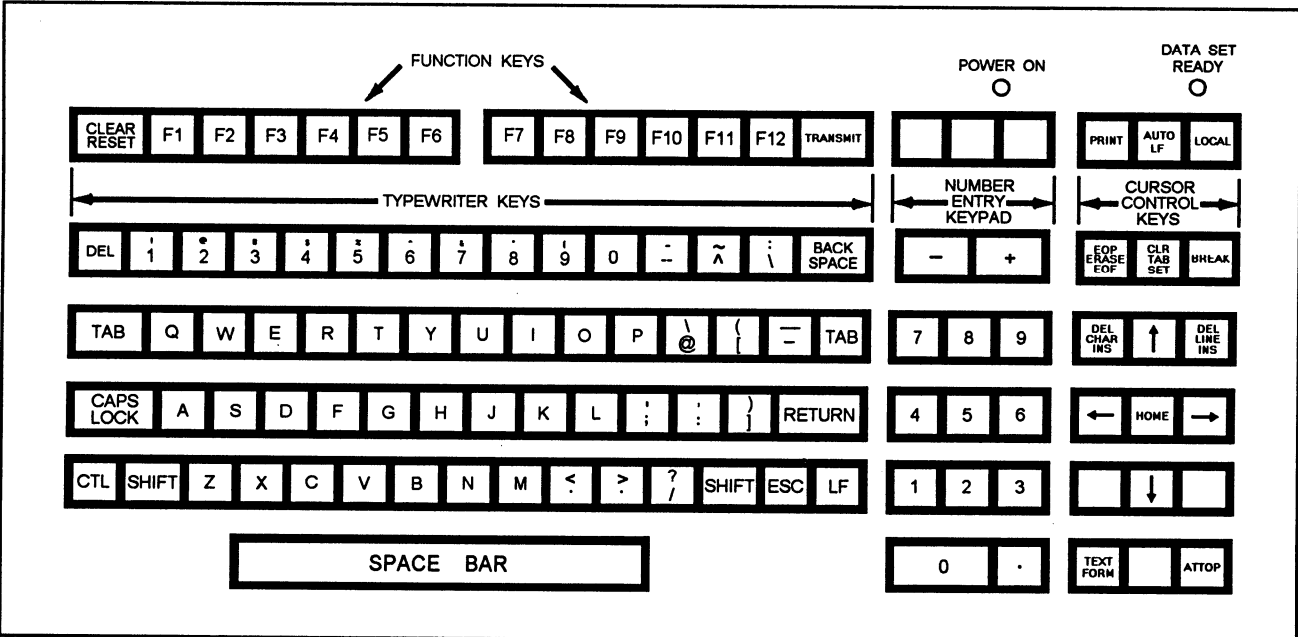
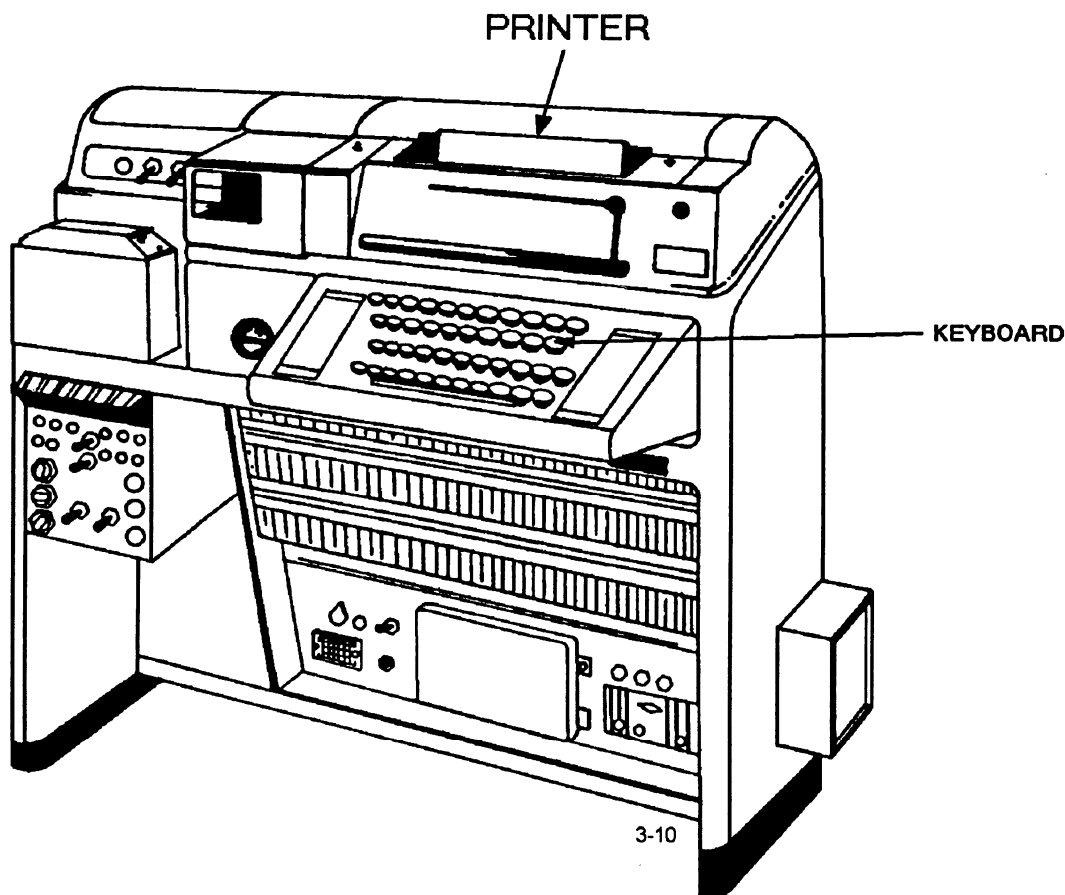Figure 3-9.—Example of a typical keyboard used with a PC.

Figure 3-10.—Example of a teletype.

commands to communicate in the system operating manuals (SOMs) and the documentation used for testing. The keyboard used with an IOCC is similar to a stand-alone keyboard except there are no special function and control keys. Figure 3-10 is an illustration of a teletype used with a computer. The teletype has two levels of controls and indications. They are as follows:

- Initiate computer operations
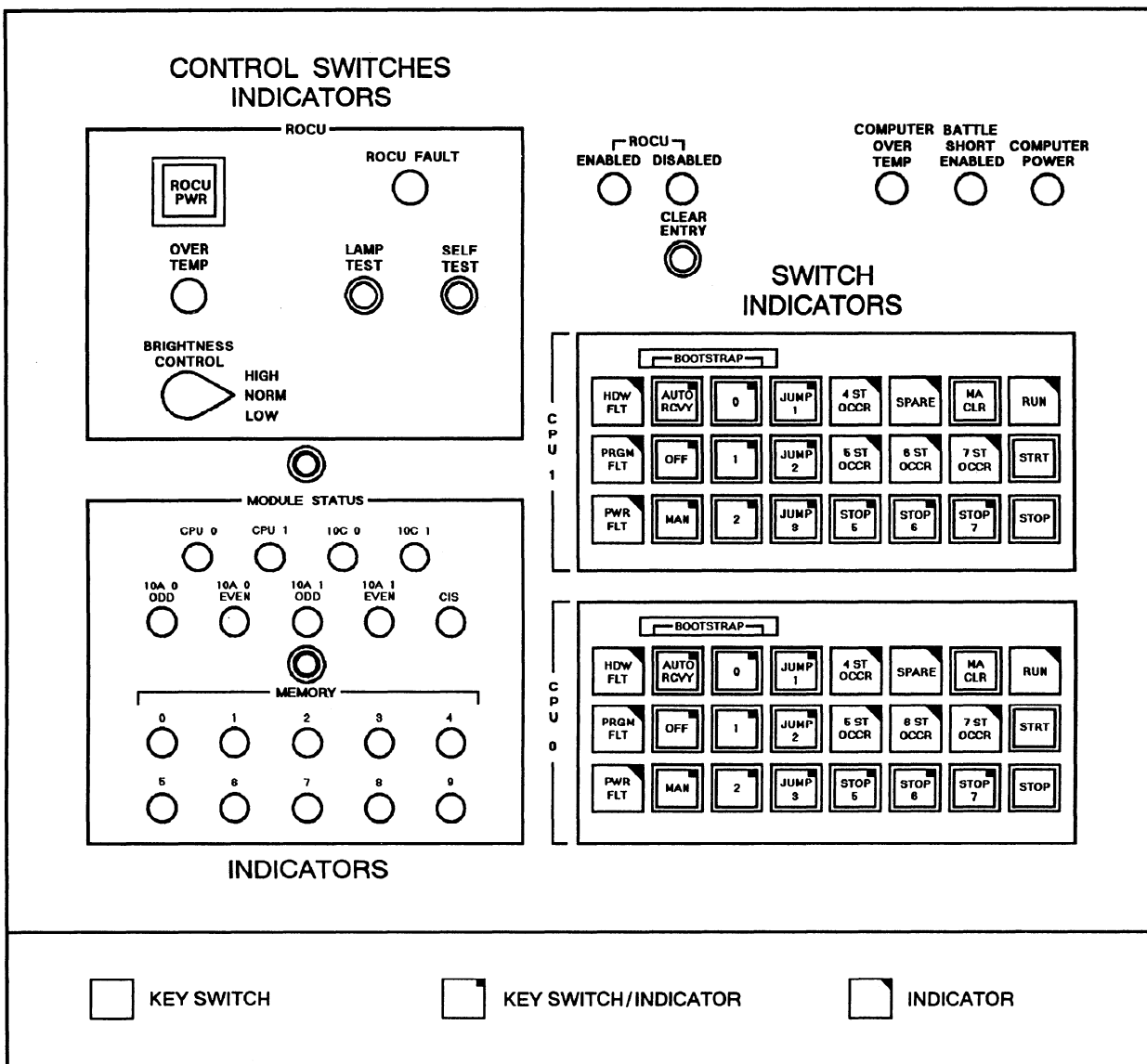
- Control computer operations

REMOTE CONSOLES AND REMOTE OPERATOR CONTROL UNITS

Remote consoles and remote operator control units (ROCUs) have controls and indicators you can use to initiate, control, and monitor computer operations. You cannot power the computer set up/down from this unit. From some remote units you can initiate, control, and monitor up to two CPUs. Other remote units only allow you to initiate, control, and monitor one CPU at a time. Some remote units have a built-in microprocessor to indicate faults and perform self-tests on the remote unit. Remote units can also indicate an overtemperature condition. More sophisticated remote units can control their own power supply, indicate if the computer is in a battle short condition, and monitor and indicate individual module status.

Remote units can be located from 150 to 300 feet from the computer. Remote consoles monitoring capabilities include switch settings, hardware availability, halts, jump stops, breakpoints on some computer sets, and operator input. Remember, key settings can interact with computer software. Depending on the technology of the remote unit, it can have up to four levels of controls and indications as follows:

- Self-testing and fault indications

- Initiate computer operations

- Control computer operations

- Monitor individual module status and overall computer status

3-13

Figure 3-11.—Example of a remote operator control unit (ROCU).

Refer to figures 3-11 and 3-12 for illustrations of remote (operator control unit) consoles of computer sets.

You have studied the various ways you can control different types of computers. You must master the controls and indicators to operate and maintain the computers and related equipment to which you are assigned.

SUMMARY—COMPUTER OPERATOR CONTROLS AND CONTROLLING UNITS

This chapter has covered computer controls and controlling units. The following information summarize important points you should have learned:

COMPUTER OPERATOR CONTROLS— You may use operator controls to manually operate the computer, affect the operation, and/or control parts of the operation.

INDICATORS— Indicators show status by turning on a light.

PROTECTIVE DEVICES— Protective devices can prevent damage to the computer or warn you of conditions that are potentially dangerous.

SWITCHES— Switches are used to turn a unit on/off, to activate a function, or to set a parameter. There are many types. Some you press, some you flip up and down, and some are combined with indicators.

COMPUTER CONTROLLING UNITS— Each computer or computer system has one or more controlling units. These units enable you to manually
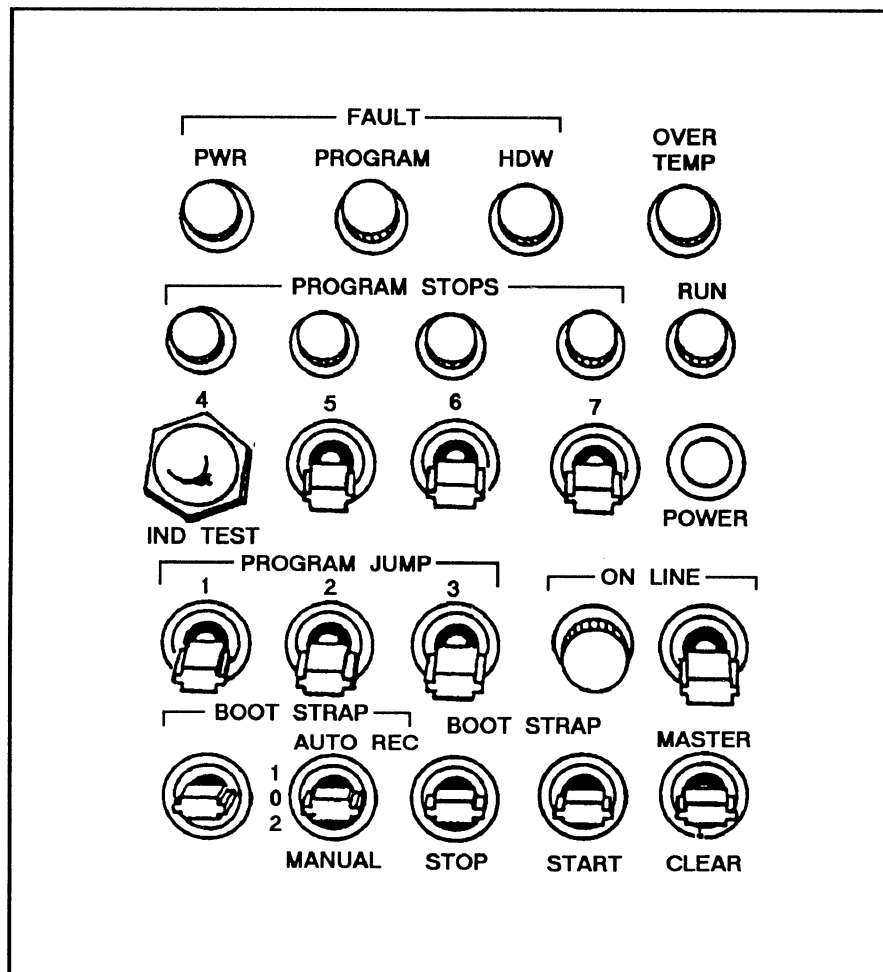
Figure 3-12.—Example of a remote console.

control the operation of the computer to some extent or to provide parameters that affect the operation. To learn the capabilities and limitations of the units on your system, look in your technical manual or owner's manual in the operation or initial setup section.

Study your technical manuals and owner's manuals. Learn all you can about the ways you can interact and control a computer from controlling units. Remember all controls and indicators are important; know what they do before activating them.